# The Safety and Efficacy of the Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (THRIVE) for Short Diagnostic Bronchoscopy Procedures

Study Protocol
NCT03086408

February 21, 2017

# STUDY PROTOCOL: THRIVE AND DIAGNOSTIC BRONCHOSCOPY

## STUDY OBJECTIVES

**1. DETERMINING THE SAFETY AND EFFICACY OF THRIVE FOR SHORT DIAGNOSTIC BRONCHOSCOPIC PROCEDURES.**

THRIVE should improve glottic and tracheal exposure, operating conditions, decrease surgical time, and potentially lead to better patient outcomes. The safety of THRIVE for short diagnostic bronchoscopy has not been formally investigated, and will be explored in this study. With the patient anesthetized, apneic, and adequately oxygenated with THRIVE, the build-up of carbon dioxide in patient's blood ($PaCO_2$) and ensuing acute hypercapnic acidosis will be the main factors limiting the duration of THRIVE administration. At present, the rate of $PaCO_2$ rise with THRIVE has not been directly investigated, but is suggested to be 1.1 mm Hg per minute. It is expected that the short duration of diagnostic bronchoscopy procedures explored in this study will not lead to substantial rise of $PaCO_2$. The $PaCO_2$ rise to 70 mm Hg is considered a safe level for moderate hypercapnia in patients without significant comorbidities (see Exclusion Criteria).

**2. DETERMINING POSSIBLE BENEFICIAL EFFECT OF THRIVE ON IMMEDIATE POSTOPERATIVE RECOVERY, OPIOD CONSUMPTION, AND FUNCTIONAL RECOVERY.**

## INCLUSION CRITERIA

Subjects presenting for short diagnostic bronchoscopy procedures under general anesthesia, including patients after bone marrow transplant (BMT).

## EXCLUSION CRITERIA

1. Patients with significantly decreased myocardial function.
2. Patients with cardiac arrhythmias.
3. Patients with significant peripheral vascular disease.

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4. Patients with known significant cerebrovascular disease.
5. Patients with significant renal insufficiency.
6. Patients with electrolyte (K+, Ca++ abnormalities).
7. Patients with increased intracranial pressure or reduced intracranial compliance.
8. Patients with skull base defects.
9. Patients with pulmonary hypertension.
10. Immunocompromised patients.
11. Patients with significant chronic lung diseases.
12. Morbidly obese patients.
13. Patients with severe and poorly controlled gatsroesophageal reflux disease.
14. Patients with hiatal hernia and full stomach patients.
15. Patient's refusal to participate in the study.
16. Patients who do not understand English or mentally handicapped.
17. Pregnant or breastfeeding patients.
18. "BMT patients with SpO2 < 90% on supplemental nasal oxygen up to 6 l/min, or those requiring non-rebreather mask to keep SpO2 > 90% will be excluded from the study."

## PROTOCOL AT A GLANCE AND STUDY END-POINTS

1. Patients will be randomly assigned to either THRIVE or ETT/SGA (control group).
2. Anesthetic management is standardized for both groups.
3. Study end-points: per data collection sheet.

# STUDY PROTOCOL: THRIVE AND DIAGNOSTIC BRONCHOSCOPY

## OPERATING ROOM PREPARATION

1. All drugs, airway supplies, eye tape, per routine.
2. 8.0 MLT ETT and SGA (i-Gel).
3. Precut large Tegaderm for securing ETT to the chin in left corner of mouth.
4. Four channel Alaris pump with:
    a. NS carrier at 50 ml/hr
    b. Propofol drip
    c. Remifentanil drip
5. 20 ml NS syringe in line for chasing the induction and IVP drugs intraop. Please minimize IVF beyond 10 ml/kg total due to high incidence of urinary retention in male patients.
6. Working PNS with pads (make sure the battery is fresh).
7. Sedline or BIS.

# STUDY PROTOCOL: THRIVE AND DIAGNOSTIC BRONCHOSCOPY

| | THRIVE GROUP | CONTROL GROUP |
|---|---|---|
| **PREOP and PREMEDICATION** | • Obtain (check for) patient's consent.<br>• Randomize the patient to either THRIVE or CONTROL group.<br>• Obtain **preop QoR15**.<br>• Peripheral IV, 20 g.<br>• Midazolam 0.007 mg/kg incremental doses to achieve sufficient anxiolysis, not to exceed 0.025 mg/kg total dose. For elderly patients (70-80 y.o), limit total dose of Midazolam to 0.5 mg. | |
| **PRE-INDUCTION:** | Place standard ASA monitors, Sedline (BIS), and peripheral nerve stimulator (TOF ulnar nerve) | |
| | • Apply THRIVE ($FiO_2$ 1.0) at 30 l/min.<br>• Make sure the patient's head is elevated 30-40° (table in BACK UP position, **not** reverse Trendelenburg). | Preoxygenate. |
| | • IV fluid loading completed: 5 ml/kg.<br>• IV Glycopyrrolate 0.2 mg if HR ≤ 50 bpm for elderly patients (70-80 y.o.).<br>• Assure all bronchoscopy supplies are ready for immediate use in THRIVE group.<br>• Both anesthesia **and** surgical time-outs completed. | |
| **INDUCTION** | • IV Remifentanil 1 mcg/kg, Propofol 2mg/kg IV, Rocuronium 0. 6mg/kg IV.<br>• Additional Remifentanil 0.5 mcg/kg and/or Propofol 0.5 mg/kg IV boluses, as required per hemodynamic responses and Sedline/BIS readings. | |
| | • Turn THRIVE to 70 l/min.<br>• Maintain jaw thrust, with oral airway as necessary, throughout the procedure. | • Mask ventilation as required.<br>• Place SGA or ETT. |
| **MAINTENANCE** | • TIVA + THRIVE ($FiO_2$ 1.0) at 70 l/min.<br>• NBP q 5 min, unless indicated more frequently. | • TIVA + $O_2$:Air; $FiO_2$ = 0.5 or higher as required<br>• NBP q 5 min, unless indicated more frequently. |

<table>
<tr><td rowspan="2">MAINTENANCE (cont.)</td><td>• If $SpO_2$ < 90%, or ventricular arrhythmias, discuss with surgeon converting to either SGA or ETT.<br>• If surgical duration more than 30 min, consider converting to either SGA or ETT.</td><td>• Mechanical ventilation to normocapnia: $EtCO_2$ 35-40 mmHg.<br>• Vt 6-8 ml/kg of predicted body weight (PBW), PEEP 5 $cmH_2O$.<br>• PBW Males = 50 + 2.3 (Height”- 60)<br>• PBW Females = 45.5 + 2.3 (Height”- 60)</td></tr>
<tr><td colspan="2">• Sedline/BIS-guided TIVA with Propofol/Remifentanil to maintain PSI 25-50 (BIS 40-60).<br>• Maintain main IV at TKO. All IV bolus drugs are chased by 15 ml of NS using in-line 20 ml syringe.<br>• TIVA dosing:<br>○ TIVA is carried in by Alaris NS carrier at 50 ml/hr.<br>○ For normal weight patients, dose Prop/Remi infusions per total body weight.<br>○ For obese patients (BMI ≥ 30), dose Prop/Remi infusions per lean body weight (LBW). Simplified LBW formula: LBW = IBW x 1.2; IBW = 22 x Ht(m)$^2$.<br>○ Propofol 80-150 mcg/kg/min, Remifentanil 0.05-0.3 mcg/kg/min. Optimize Remifentanil dose first.<br>○ Rocuronium boluses 0.15 mg/kg, to maintain 0-1/4 TOF at ulnar nerve.<br>• Treating hypertensive responses (MAP > 20 mmHg from baseline):<br>○ Remifentanil 0.5 mcg/kg and Propofol 0.5 mg/kg boluses q 2 min, as required per hemodynamic responses and Sedline/BIS readings<br>○ Labetalol 0.07 mg/kg boluses q 10 min up to a total dose of 1 mg/kg, as required per hemodynamic responses and Sedline/BIS readings<br>○ Fentanyl 0.5 mcg/kg IV bolus, total dose limit 1 mcg/kg, only if perceived need for additional analgesia after Remifentanil had been maxed out at 0.3 mcg/kg<br>• Treating hypotensive responses (MAP < 20 mmHg from baseline):<br>○ Crystalloid loading 5 ml/kg x 1<br>○ Ephedrine 5 mg IV if HR < 60 bpm, or Phenylephrine 100 mcg IV if HR > 60 bpm</td></tr>
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<ul>
<li>Vasopressin 1 unit IVP prn, as required</li>
<li>Phenylephrine drip, as required, start at 0.3 mcg/kg/min, increase in 50% increments</li>
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<tr><td rowspan="2">EMERGENCE</td><td colspan="2">
<ul>
<li>Zofran 4 mg IV.</li>
<li>Reverse NMB with Suggamadex, as following: 2 mg/kg for TOF 1-2/4; 4 mg/kg for TOF 0/4, with postetanic count of 1-2.</li>
<li>Discontinue TIVA and disconnect TIVA line upon completion of surgery.</li>
<li>Transport to PACU: $FMO_2$ at 6 l/min.</li>
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<ul>
<li>Maintain THRIVE at 70 l/min with jaw thrust ± oral airway as required, until return of spontaneous ventilation and consciousness.</li>
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<li>Extubate per routine.</li>
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<tr><td>STANDARDIZED POSTOP ORDERS</td><td colspan="2">
<ul>
<li>IV Fentanyl 25 mcg boluses q 5 min prn VAS ≥ 4, total dose 250 mcg.</li>
<li>PO Hydrocodone-acetaminophen (NORCO) 5-325 mg, 1 tab prn VAS ≥ 4, may repeat x 1.</li>
<li>If allergic to NORCO, Oxycodone-acetaminophen (PERCOCET) 5-325 mg, 1 tab prn VAS ≥ 4, may repeat x 1.</li>
<li>IV Demerol 10 mg for shivering only, may repeat x 1.</li>
<li>Treatment of PONV:
<ul>
<li>Zofran 8 mg IV x 1</li>
<li>If no effect, and no contraindications, add IV Promethazine 12.5 mg x 1</li>
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<tr><td>PACU DATA COLLECTION</td><td colspan="2">
<ul>
<li>Obtain PACU data collection sheet and QoR15.</li>
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<tr><td>QUESTIONNAIRES and DIARIES</td><td colspan="2">
<ul>
<li>Pre- and post-procedural QoR15 questionnaires and post-procedural home diaries will be given to the patients. The BMT patients will receive QoR15 questionnaires, but will not keep the home diaries.</li>
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# STUDY PROTOCOL: THRIVE AND DIAGNOSTIC BRONCHOSCOPY

| THRIVE PROTOCOL | |
|---|---|
| **PREOP** | • Randomize patient to THRIVE or ETT group. |
| **PREINDUCTION** | • Start THRIVE @ 30 l/min immediately, before applying other OR monitors.<br>• Maintain patient's head elevated 30-40°, with table in BACK UP, **not** reverse Trendelenburg position. |
| **INDUCTION** | • THRIVE @ 70 l/min.<br>• Place an oral intubating airway and maintain a jaw thrust for introduction of the fiberoptic scope by surgeon. |
| **MAINTENANCE** | • Maintain THRIVE @ 70 l/min.<br>• Maintain jaw thrust with the intubating oral airway in place for the duration of the procedure.<br>• **If surgery prolonged (over 30 min), consider converting to either SGA or ETT.** |
| **EMERGENCE** | • Maintain THRIVE at 70 l/min with jaw thrust ± oral airway as required, until return of spontaneous ventilation and consciousness. |